

Center for Independent Experts
(CIE) Peer Review of the Study,
“Recommendations for Excessive
Share Limits in the Northeast
Multispecies Fishery

JULY 22, 2014

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Executive Summary

The New England Fishery Management Council (NEFMC) consulted with Compass Lexecon (CL) regarding the implementation of an access privilege quota system in the Northeast Multispecies Fishery (NMF). The concerns of the NEFMC were the accumulation of excessive shares or the further increase of excessive shares if they already existed. The report (CLR), entitled *Recommendations for Excessive-Share Limits in the Northeast Multispecies Fishery* was written by Glenn Mitchel and Steven Peterson (authors) in 2013. The Northeast Multispecies Fishery (or the “ground fish” fishery, as it includes thirteen species of groundfish) spans the Gulf of Maine, Georges Bank, Southern New England and the Mid Atlantic Bight. The fishery is regulated by sectors (contractually related groups of permit owners) that directly manage catch levels and annual catch limits (ACLs). The main conclusion of the report is that market power (MP) is not being exercised in the fishery through the withholding of Annual Catch Entitlement (ACE) in any part of the groundfish fishery.

It is my opinion that insufficient information was presented by Mitchel and Peterson (2013) to verify CL’s finding that market power is not being exerted in either product or ACE trading markets. However, based on additional information at the meeting and general experience no market power is indicated in either product or ACE trading markets. Conditional on the above, there is no need for a market power limit. Also, future conditions of the fishery will determine the need for regulation.

To draw conclusions about market power in the NMF, one needs to have both theoretical and empirical evidence on:

1. The competitive equilibrium output level
2. The actual quota levels
3. Actual output relative to the quota level
4. If market power exists, how did it come about (e.g., through dominant firm pricing, or buying out the competition)

The reasons why I don't agree with the CLR are:

1. Both the microeconomic theory and the determination of the quota were not adequately described. Fishermen make production decisions subject to the production quotas set by regulators. Proper analysis must discuss anti-competitive behavior within a quota-based model, relative to competitive equilibrium. In this context, under-used quota could be due to monopoly pricing.
2. There was no information on whether the sample of people interviewed was representative of the population.
3. There is no scientific basis for ruling out the possibility that sector level coordination may occur.
4. There was no statistical analysis of the product market or demand. They described the process for determining relevant markets, but did not fully consider the relevant market that includes imports.

5. There was no consideration given to the relevant literature on demand price elasticities in a multiple species framework.
6. Full consideration was not given to aggregate markets that would include the role of imports or substitutions among fish species.
7. Given several species in a multispecies market, there is no discussion of the possibility of price manipulation in only one or two of the species markets out of the total.
8. There is no discussion as to why the authors did not estimate directly, through econometric means, market power directly.
9. The unit of regulation should be any level that allows for institutions to coordinate activities to behave non-competitively. There is no scientific basis for ruling out the possibility that sector level coordination may occur.

Background

NEFMC is preparing Amendment 18 to the Northeast Multispecies Fishery Management Plan (FMP). Among other things under consideration, Amendment 18 would establish an excessive share threshold for the fishery consistent with National Standard 4 of the Magnuson Stevens Fishery Conservation and Management Act. To provide the needed expertise to establish an excessive share threshold the NEFMC contracted the economic consulting firm Compass Lexecon (see Annex 1 for Compass Lexecon's TORs) to conduct an empirical analysis to determine if excessive shares existed in the fishery today as well as the necessary constraints to prevent accumulation

of excessive share in the future. Compass Lexecon completed its study and submitted its final report to the NEFMC on December 31, 2013.

At the request of the NEFMC a review panel was convened to provide a peer review of the CLR. I was one of the four peer review panel experts (see Appendix 3) under a contractual arrangement between the National Marine Fishery Service (NMFS) Office of Science and Technology and the Center for Independent Experts (CIE). Also, one expert was contracted by the NEFMC (see Annex 3 for panelist names and affiliations). The peer review took place in Salem, MA on June 12-13, 2014. The peer review panel was chaired by a member of the NEFMC's Science and Statistical Committee (SSC). Peer reviewers were provided with the CLR, a multispecies fishery background document, the meeting announcement, and the TORs for the peer review.

The panel review meeting consisted of a session on June 12th that was open to the public and a session on June 13th that was not. The June 12th session (see Annex 4 for the meeting agenda) began with a presentation provided by Council staff on the purpose and need for the excessive share study of the Northeast Multispecies fishery conducted by CL. This presentation was followed by an overview provided by CL's lead investigators of their methods, data, and findings. Throughout these two presentations the review panel sought clarification on both the operational aspects of the Northeast Multispecies Sector Allocation program and CL's procedures in the conduct of the excessive share study. During the afternoon of the 12th the review panel sought additional clarification on each of the panel's TOR for the peer review. Answers to the panelist's questions were provided by CL's lead investigators, Council staff, Greater

Atlantic Regional Fisheries Office (GARFO) staff, and the Northeast Fisheries Science Center's (NEFMC) Social Sciences Branch (SSB) staff. These deliberations were informed by comments from members of the public in attendance.

On June 13th the review panel met to further discuss the peer review TORs where attendance was limited to the members of the peer review panel, the panel chair, and staff from the Council, GARFO, and NEFSC's SSB. The peer review panel succeeded in addressing all of the TORs. The peer review panel's findings on each of the TORs are noted below.

The terms of reference (TORs) used for the Compass Lexecon study are:

1. Describe a theoretically sound method to specify the maximum possible allowable percentage share of the market for the fishery access privileges (permits, potential sector contribution) and/or the quota leasing (ACE trading) that would prevent an entity from obtaining an excessive share of the access privileges allocated under the Northeast Multispecies Fishery. Use the Herfindahl-Hirschman Index prescribed within the "US Department of Justice Horizontal Merger Guidelines" or other accepted rule as appropriate.
2. Apply the process or rule developed under Number 1 to determine if excessive shares already exist in this fishery. If excessive shares do not exist today, describe potential constraints that could prevent excessive shares from existing in the future. Alternatively, if excessive shares do exist, describe a process or rule that will allow for a theoretically sound procedure to prevent future increase.

3. If the rule cannot be applied because of incomplete data, provide suggestions of how to apply the rule in the best way possible that is consistent with the theoretical underpinnings of the rule. Also, identify data that would be necessary to apply the rule.
4. Identify conditions where entities, could exert “inordinate control” of quota as outlined in the National Standard 4 Guidelines. Such entities could include business entities holding permits, sectors, or organizations of sectors.
5. Alternate approaches to achieving the Amendment 18 goals (other than accumulation caps) may be proposed.

My peer review was conducted based on the following TORs:

1. Describe the method or process used by Compass Lexecon for determining the maximum possible allowable percentage share of the market for fishery access privileges and/or quota leasing that would prevent an entity from obtaining an excessive share of access privileges allocated in the Northeast Multispecies Fishery.
2. Evaluate the strengths and weaknesses of the proposed method or process developed by Compass Lexecon (e.g., whether defining excessive shares in terms of market power is appropriate and adequate). Evaluate whether the approach outlined by Compass Lexecon is appropriate. As part of this TOR, comment on any constraints that may hinder application of the proposed outlined by Compass Lexecon is reasonable for setting excessive share limits in fisheries managed through catch shares in a general approach.
3. Evaluate application of the proposed methods or process to the Northeast Multispecies Fishery. Are Compass Lexecon’s conclusions regarding market power in both the final

product (seafood) and production (quota) market valid and based on appropriate economic principles? If there is disagreement with what Compass Lexecon recommended, clearly state that and your reason why.

4. Review and comment on the data requirements necessary for applying the proposed methods or process.

5. Provide any recommendations for further improvement.

Within this context, my review is based on NEFMC and NMFS (2014), Anderson and Holliday (2007), Mitchel and Peterson (2013), my expertise in the area, and information gleaned from comments made by participants of the June 12-13 meetings, including panel members, the authors of the CLR, fishery personnel, and the general public.

Description of Role

My responsibilities during the Review Activities were to familiarize myself with the background information, and to participate in the discussion. I also functioned as a review panelist.

Summary of Findings

The following is my peer review according to the TORs provided:

TOR1. Describe the method or process used by Compass Lexecon for determining the maximum possible allowable percentage share of the market for fishery access privileges and/or quota leasing that would prevent an entity from obtaining an excessive share of access privileges allocated in the Northeast Multispecies Fishery.

The process used by Compass Lexecon included the following:

1. Qualitative data was collected on the product market and ACE trading markets through unstructured voluntary interviews
2. A 7-step process was applied to determine an excessive share cap
3. The Herfindahl Hirschman Index (HHI) was used to measure concentration from data provided by NMFS
 - 3.1. The HHI was calculated at the Group-ID level for:
 - 3.1.1. Yearly harvest by species (Table 1)
 - 3.1.2. Yearly ACE holdings by species (Table 6) and stock (Table 7)
 - 3.2. The HHI was calculated at the sector level for:
 - 3.2.1. Yearly ACE holdings by species (Table 3) and stocks (Table 4)
4. Horizontal Merger Guidelines were used to evaluate levels of the HHI
 - 4.1. A HHI of 1500 was selected as the level consistent with competitive markets

Data sources: NMFS Group identification at both the individual and sector levels was based on potential sector contribution (PSC), ACE, and landings. Also, import/export data were obtained from the National Oceanic and Atmospheric Association (NOAA). Qualitative data were collected voluntary through unstructured interviews with vessel owners, sector managers, Northeast Seafood Coalition, Auction house, and processors. There was also a webinar that included approximately 25 participants. The bibliography contains additional sources of information.

TOR2. Evaluate the strengths and weaknesses of the proposed method or process developed by Compass Lexecon (e.g., whether defining excessive shares in terms of market power is appropriate and adequate). Evaluate whether the approach outlined by Compass Lexecon is reasonable for setting excessive share limits in fisheries managed through catch shares in general. As part of this TOR, comment on any constraints that may hinder application of the proposed approach.

The peer review panel concurred that defining market power in terms of excessive shares is appropriate. However, the review panel noted a number of concerns with the procedures used by CL in developing its recommendations. I concur with the panel.

Major concerns include:

1. The CLR has a weak theoretical conceptualization of the problem at hand. In order to do this study properly, they needed to develop a detailed theoretical model of market power in a regulated multiproduct fishery setting and discuss empirical results in this context.
2. There was also no consideration of production function or cost relationships and no consideration of implications for economies of scale and multi-product cost relationships.
3. The theory needed to incorporate a discussion on regulators who set production quotas relative to the competitive equilibrium solution benchmark against which market power is measured.
4. Aside from theoretical considerations, another shortcoming of the CLR was the lack of documentation regarding the determination of the relevant market for groundfish in the Northeast.

5. Similar to the previous point, there was a lack of documentation provided regarding both the survey methods and the questions used to generate qualitative information.
6. The CLR did not seem to consider future conditions in the NMF. The authors also did not have a scientific basis for ruling out the possibility that sector-level coordination would not occur (the primary basis for this conclusion was information gleaned from the interviews that were conducted).

TOR3. Evaluate application of the proposed methods or process to the Northeast Multispecies Fishery. Are Compass Lexecon's conclusions regarding market power in both the final product (seafood) and production (quota) market valid and based on appropriate economic principles? If there is disagreement with what Compass Lexecon recommended, clearly state that and your reason why.

The peer review panel found that the information included in the CLR was not sufficient to conclude that market power is being exerted in both the final product market and ACE trading market. The review panel did not necessarily disagree with CL's findings. It was the consensus of the review panel that the scientific basis to validate their findings was lacking. I concur with the panel.

The quantitative analysis underlying their findings is weak. Mitchel and Peterson (2013) imply that they used statistical methods and mathematical modeling, but I find neither. The authors needed to take into account (in a more rigorous manner), the nature of the multispecies fishery, and therefore need to determine the cross-price elasticities of demand for multiple species. There is no theoretical foundation or model to support the

evaluation of market power (MP) in ACE markets. One is dealing with a multiproduct market and there is no specific guidance on determination of market power in this setting.

A major limitation of the CLR is that there is no statistical analysis of the product market or demand. They described the process for determining relevant markets, but did not fully consider the relevant market that includes imports. There was no consideration given to the relevant literature on demand price elasticities in a multiple species framework. Full consideration was not given to aggregate markets that would include the role of imports or substitutions among fish species. There was insufficient information given which makes it nearly impossible to replicate the authors' methodology. The CLR concluded that underutilization of quota may be evidence of potential market power (page 41 Section c).

The question arises as to why the authors did not estimate market power directly through the econometric techniques that have often been reported in relevant literature. This would have required demand elasticities to be estimated for multiple species. But, by so doing, the authors would have shed a great deal of light on the degree of competition in the fishing industry. In this framework, why is there no discussion of the possibility of price manipulation for at least one or two of the species? Is it not possible that for at least one of the species (not necessarily all of them), price collusion exists?

Additional Details

1. Evidence in Product Market

- 1.1. The description of product markets was insufficient even in general terms. Broader consideration of the aggregate market, role of imports and substitutability among products should have been evaluated. While a formal statistical analysis of market demand may not have been possible, a review of the relevant literature would have been informative, and would have bolstered the case for a competitive product market.
- 1.2. It may have been possible to directly test for market power in the product market using established econometric methods. These methods could have been applied by CL or the reasons why such testing could not be done for this fishery should be noted.

2. ACE Trading Market

- 2.1. In the Northeast Multispecies sector allocation program there are two markets: one for PSC (permanent share) and one for ACE. However, the share limit would apply to PSC and not to ACE. CL notes that the demand for ACE is downward sloping, but there is no information on the slope of the demand curve. Absent ACE trading data, there is no underlying scientific basis for finding that ACE trading markets are competitive or otherwise.
- 2.2. The conditions under which the ability to exert market power in multiproduct ACE market have not yet been established in the economic literature. This has

implications for whether there is any theoretical or empirical basis for setting any specific excessive share limit.

Findings of the Panel

The panel finds that insufficient information was presented to verify CL's finding that market power is not being exerted in either product or ACE trading markets under current conditions. I agree. However, based on additional information from the two day June 11-13 meeting and general experience with the industry, I conclude that no market power is indicated in either product or ACE trading markets under current conditions. Therefore there is no need for a market power limit.¹

The seven-step process: The authors argue that MP isn't being exercised in the NMFS. With respect to recommending excessive-share caps, they follow the seven-step procedure discussed below, upon which I provide comments:

1. *Assess quota ownership information:* The information NMFS has on permit ownership may not be sufficient, for all potential permit transactions, to reliably define ownership and control of permits and the PSC they confer.

Comment: Even though the authors have information on individual permit holders and permit holders by sector, their argument that sectors cannot exert market power is very weak and is not supported by either theory or empirical evidence. They do not fully explore the possibility that many

¹ A general concern is the CLR's determination that market power is not exerted at the sector level. There is no theoretical foundation or model to support the evaluation of market power (MP) in ACE markets. One is dealing with a multiproduct market and there is no specific guidance on determination of market power in this setting. It is difficult to determine MP when the authors do not provide any information on price elasticities of demand. The conditions under which the ability to exert market power in multiproduct ACE markets have not yet been established in economic literature.

permit owners may operate under the same identity (i.e., who owns what permit). It seems that some crucial questions not addressed are: who owns the permits and how fish is caught by those owning permits?

2. *Assess competitive information:* There is sufficient competitive information to determine that the relevant markets for ACE trading are the markets for the trading of each stock's ACE. If an operator requires the ACE for a particular stock, there is not a good substitute available.

Comment: In the summary section of their report, the authors conclude that there is sufficient competitive information to proceed with the determination of an excessive share cap. Why discuss excessive share caps when there appears to be excess competition in the industry? How much consolidation would there have to be before the recommended caps would be binding? The necessary amount of consolidation required to exert market power is far beyond conditions that currently exist in the fishing industry.

3. *Check threshold condition:* One cannot exclude the possibility of the exercise of market power as the result of the fishery's output regularly reaching the regulated level, which would indicate competitive conduct within the framework of the output regulation. Thus, examination of appropriate caps is necessary.

Comment: There is no evidence provided on where the quota is set, relative to competition. In Figure 1 below, if the regulator sets output at q_1 , the firms would behave as a monopolist by charging p_1 .

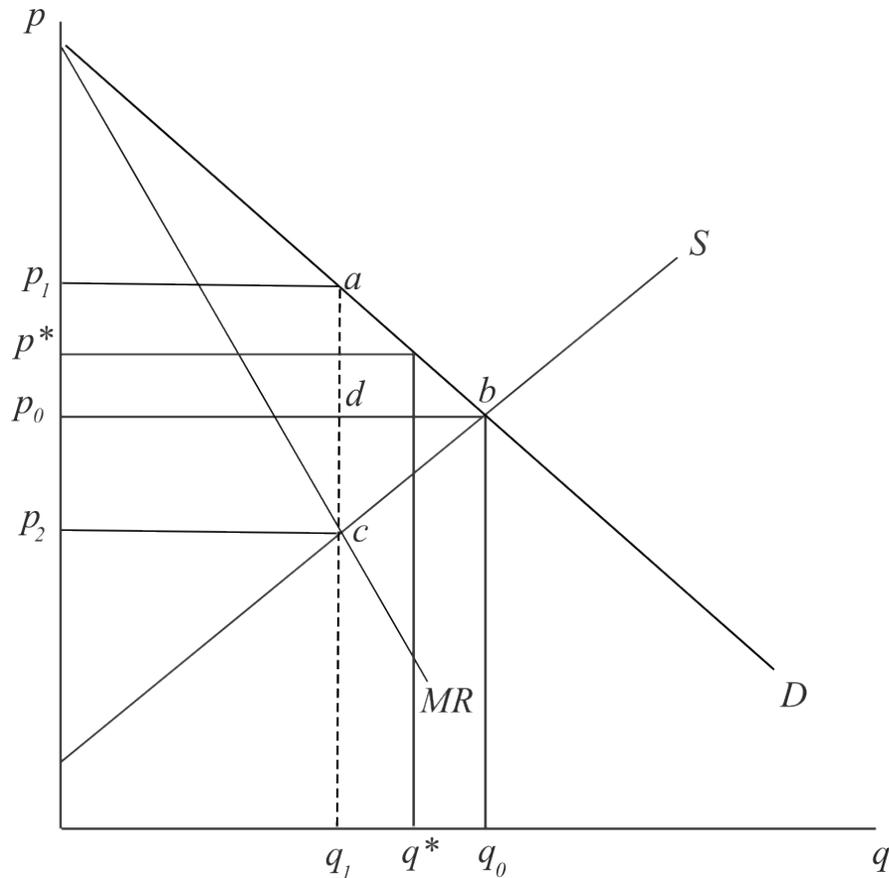


Figure 1. Competitive Equilibrium, Quota Level, and Monopoly Output

They gain from the quota in the amount $(p_1 p_0 da) - (dcb)$. It is true that firms would not attempt to restrict output below q_1 because there would be a loss from doing so. I agree with the authors' statement because in this context, an excessive share limit has no meaning.

Now consider a quota set by the regulators for example, at the competitive equilibrium quantity q_0 . In this case, the quota level is well beyond the monopoly levels q_1 . But this does not imply that monopoly pricing does not exist. Consider the case where firms monopolize, and produce q^* and receive price p^* in the presence of quota q_0 . In this case, output is less than the quota imposed. The very

nature of monopolization implies that output be restricted below the quota set by the regulator (except in the case of q_1). Therefore, if q^* exists as an amount smaller than q_0 , there is concern for monopoly pricing. The problem that arises is of an empirical nature. One has to empirically determine the competitive equilibrium in relation to the quota level, and actual fishery output. However the existence of unused quota does not necessarily imply non-competitive behavior. In the model presented above, $(q_0 - q^*)$ represents unused quota. I find no evidence of these calculations.

An important quote is taken from the CLR (p. iv):

“...there has been substantial underutilization of allowable catch for many species with ACE data, especially in 2012. Haddock landings, for example, accounted for just 21 percent of ACE in 2010 and dropped further to just 4 percent in 2012. Cod landings were over 80 percent of ACE in 2010 and 2011, but dropped under 45 percent in 2012.”

As the above model shows, excess capacity is consistent with monopoly pricing.

In regard to the exercise of market power, it is important to keep the definition of excessive share limits firmly in mind. The authors define an excessive share to be a share of access rights that would allow a permit owner or sector to influence to its advantage the prices of the fishery's output or the prices paid for leased ACE (p i). The author's go on to state (p 1):

“There is no standard economic definition of “excessive shares.” However, the fishery management plan must comply with National Standard 4 of the Magnuson Stevens Fishery Conservation and Management Act. The National Standard 4 Guidelines state:

An allocation scheme must be designed to deter any person or other entity from acquiring an excessive share of fishing privileges, and to avoid creating conditions fostering inordinate control, by buyers or sellers, which would not otherwise exist.

From a broad economic perspective regarding what could constitute “inordinate control,” we define an excessive share to be a share of access rights that would allow a permit owner or sector to influence to its advantage the prices of the fishery’s output, the prices paid for leased Annual Catch Entitlements (“ACE”), or prices paid for permits. Such influence may disadvantage other holders of fishery access rights relative to prices that would otherwise result. The ability to manipulate prices to one’s advantage based on the share of participation in a market is a typical example of what economists call market power.”

In the above context, consider for example, where through monopolization, output is restricted to q^* . Theoretically, several means are potentially available to fishermen to achieve this outcome. One approach, as discussed in Appendix 4, is through dominant firm pricing, whereby the dominant firm, relative to competition, reduces output. Alternatively, a model exists where several large producers could essentially buyout the fringe suppliers and achieve a monopoly. In this case, output increases for the larger firms and smaller firms exit the industry, giving rise to a reduction in total quantity, relative to the competitive levels.² Now a key question arises: How does one interpret the data on actual fish catch by individual fishermen? Are the data consistent with monopolization, and if so, by what means?

4. *Establish concentration targets:* It is reasonable for the NEFMC to recommend that the NMFS establish an excessive-share cap to maintain an *unconcentrated* (HHI

² There are additional models of non-competitive price behavior that could be considered, such as Cournot-Nash and Stackelberg.

below approximately 1,500) distribution of PSC by capping individual the PSC for each stock that can be conferred to any permit owner.

Comment: Why establish concentration targets if no MP exists? In the report (p. v), the authors determine that this target can be achieved without interfering with economies of scale. Unfortunately, the authors do not rigorously determine or describe economies of scale in the fishing industry (both currently and in the future). It may well be that the authors are implying that caps may be imposed due to future monopolization and economies of scale.

5. *Determine share limit-market concentration relationship:* The cap required to ensure an HHI below 1,500 would be 25 percent with a competitive fringe of 38 percent, or 15.5 percent with no competitive fringe.

Comment: This is also misleading because a cap is not needed if there is no market power exercised.

6. *Identify regulatory and practical constraints:* Sectors do not own or control PSC or ACE. Therefore, capping the amount of PSC or ACE held in the aggregate by members of a particular sector would not provide protections against the exercise of market power or the development of inordinate control.

Comment: I totally agree.

7. *Recommend an excessive shares cap:* I suggest using the grouping of permits by common ownership (based on information already available) for an initial determination of whether a permit transfer exceeds a share cap, but allowing for an optional follow-up submission of detailed ownership information prior to final

determination. I recommend setting an excessive-share cap so that no permit owner owns or controls permits conferring more than 15.5 percent of the PSC for a stock.

Comment: In the executive summary point 7, (p. 9), the authors conclude:

“...given the lack of evidence for scale economies continuing to occur for individual owners above 10 to 12 percent of a stock’s ACE, we recommend setting an excessive-share cap on the PSC conferred to permit owner at 15.5 percent of available PSC.”

The authors provide little evidence of scale economies and about the nature of the supply curve for fish in general. The cost curve for the fishery may well decrease over time due to economies of scale brought about by new technologies. Without intervention, at least theoretically, this leads to a natural monopoly solution. If this were the case, then it seems like some form of a future cap would be in order.

TOR4. Review and comment on the data requirements necessary for applying the proposed methods or process.

1. The analysis conducted by CL was based on groupids. The NEFMC is considering adopting a share limit at the person level—an approach that would require information on ownership stake. Setting limits at the person level would complicate the use of the HHI as a means for setting a share limit or monitoring the performance of the fishery.
2. In addition to the information needed to set and monitor share limits it is necessary to:
 - 2.1. create of an ownership registry to include transactions and prices.
 - 2.2. conduct cost and earnings studies at the vessel and sector level

- 2.3. monitor the price of quota. If it is near zero and ACL is not exceeded, then there is evidence of a competitive market. Likewise an increase in quota prices may be reason for concern.

TOR5. Provide any recommendations for further improvement.

As previously stated, the CLR provides little theoretical basis for its findings. I recommend that further work in this area of monopolistic pricing should follow the discussion below. This model discusses the potential for price-fixing within the context of production quotas that may be set by a regulatory agency. These quotas are set based on the concept of a sustainable fish yield, and often do not have any bearing to competition as defined by economists. The major conclusion is that determining anti-competitive behavior in the fishing industry is extremely difficult as the following models show. This is because the quotas are set based on biological principles, and this quota may be far from that determined by competitive equilibrium economic conditions. Quotas can give rise to rents for fisherman because of the quantity restriction by about three quarters. To determine anti-competitive behavior, one has to know imperially the competitive price and quantities and these have to be related to the quantities set by the regulator and the amount actually produced by fisherman.

1. Consider the model presented in Figure 2. The total demand for fish is given by D and total supply of fish by S . Assume that of the total supply S , three larger firms out of a total of 20 produce output (fish) q^* , while the remaining firms produce $(q_0 - q^*)$ of fish at a price p_0 (the fringe suppliers constitute the 17 firms). S^* is the supply

curve of the dominant firm, and is assumed to be equal to the supply curve of the fringe suppliers.

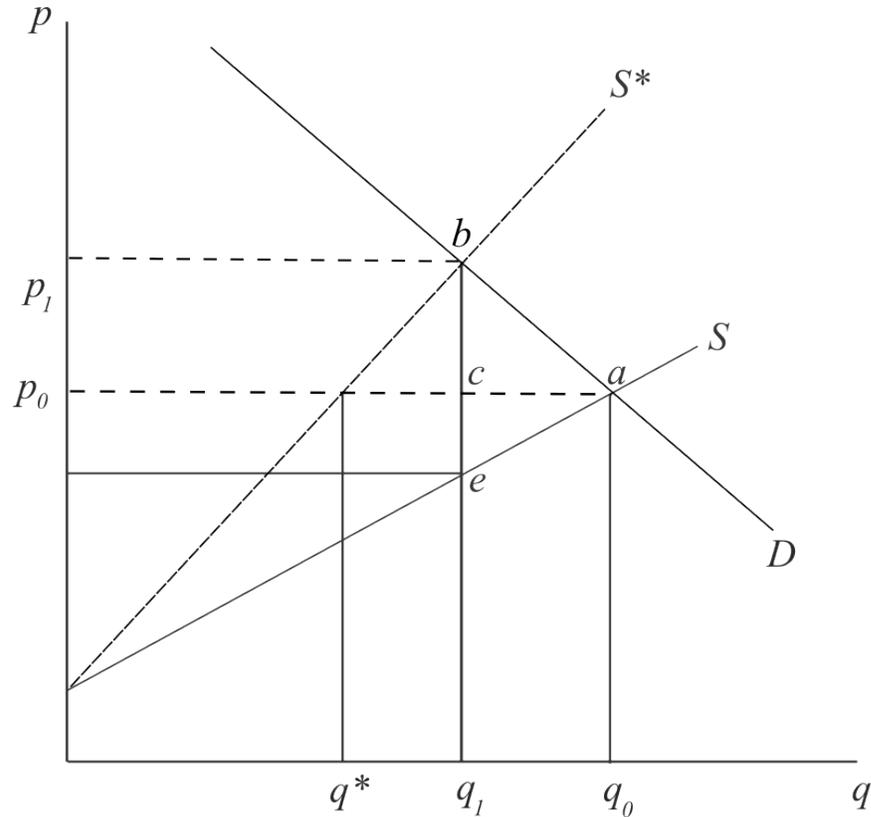


Figure 2. Introduction of quota in a fishery

Under standard welfare analysis, producing q_0 of fish at a price p_0 leads to the social optimum. However quotas can lead to social optimality in the presence of negative externalities (i.e., over-fishing if left to unfettered market forces).

Consider the introduction of a production quota q_1 that raises price to p_1 . As a result of the quota, consumer lose $(p_1 p a b)$, producers gain $[(p_1 p c b) - (c e a)]$ and there is a net efficiency loss of $(b e a)$. A production quota is a second best policy based on conventional welfare economics.

The intent of setting a quota on fishing is not to create a second-best solution. For a quota to improve welfare over competitive levels, there has to exist some form of a negative externality generated from the free market solution. If the social optimum is at q_1p_1 and not q_0p_0 , then producers are better off by $[(p_1p_0cb) - (cea)]$. Consumers in the long run would also gain as a sustainable amount of fish would be available at a catch rate that guarantees q_1 of product. Hence, the argument is that competition leads to over fishing, and regulators, at least in theory, set the quota at q_1 .

2. Here, the argument made is that the quota is needed to achieve a first best policy solution. In Figure 3 the competitive solution is point d , but under a quota, the price is p_1 and the corresponding quantity is q_1 . The quota is used here to correct the negative externality. But, the producers gain from the quota by an amount $[(p_1p_0ab) - (acd)]$. This is because producers' variable costs are only (ghq_1c) to produce output q_1 .

Suppose instead of using a quota to correct the externality, a producer tax is imposed of $(igcb)$. Now producers lose by an amount $[(p_0gd) - (p_1ib)]$. Producers clearly support a production quota over a production tax.

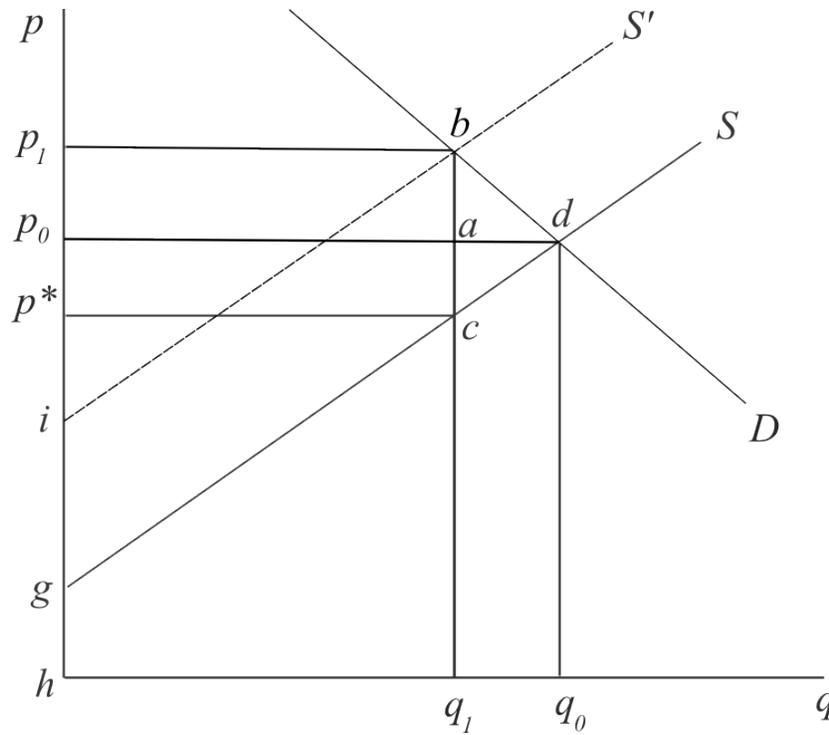


Figure 3. Production Quota vs Production Tax

3. The CLR suggests the possibility that part of the amount of production is less than allowed under the quota. Consider Figure 4 where this is the case, but from a different perspective than discussed above. The production quota is set at q_1 to the right of the competitive output q_0 . However, in the absence of a production subsidy, producers only produce q_0 , the competitive equilibrium quantity. If they produced quantity q_1 instead, they would experience a loss of $(p_1 j y x)$.

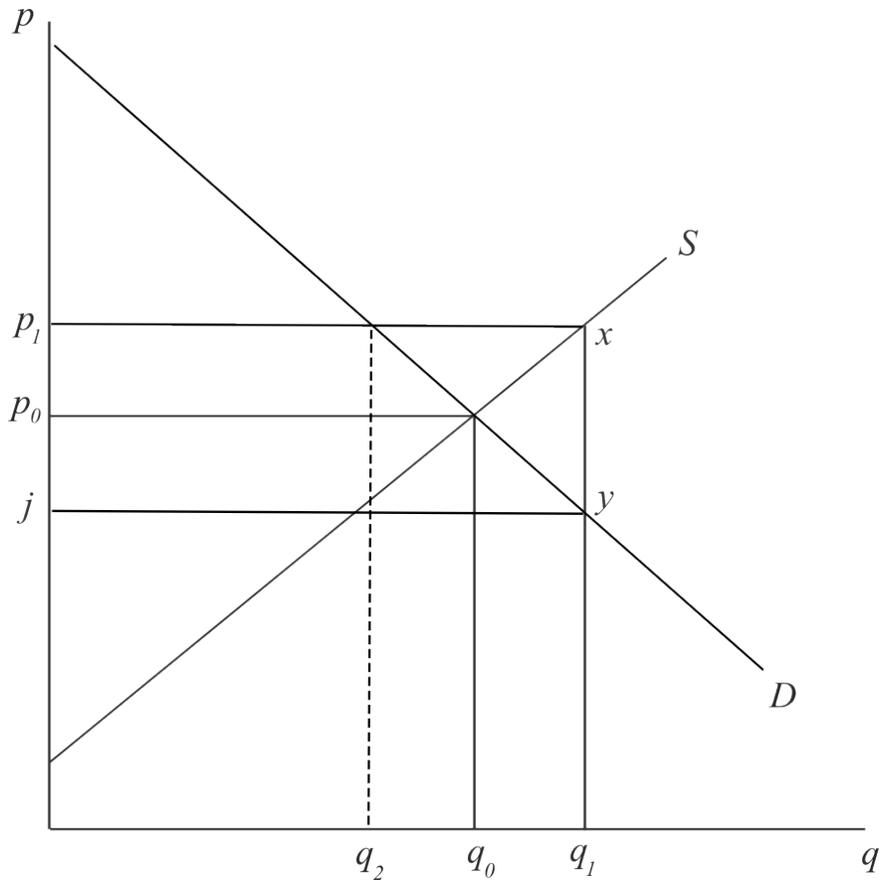


Figure 4. Unused Quota

As a caveat, one could argue that given the optimal quota q_1 (set so that there is no overfishing of this amount), a positive externality exists hence a production subsidy is one possible instrument to correct for the externality.

In the model, the norm against which to assess the competitive nature of the industry is with reference to p_0 and q_0 , not the unused quota of (q_1, q_0) . Furthermore, unlike the earlier discussion where the quota is binding, the chances for a strategy by the dominant firms to raise prices is no more likely to be pursued since the payoff to the dominant firm is now with reference to p_0 and q_0 , and not some binding quota of q_2 . In

the latter case, part of the rents to producers have already been obtained as a result of the quota itself.

4. With reference to unused quota, there are at least two possible conclusions that can be drawn. The first is where production is less than under a binding quota and the second is where quota is set at a level that exceeds the competitive equilibrium quantity. Both cases are discussed with reference to Figure 5. A binding quota of q_2 leads to price of p_2 and a quantity of q_2 . In this case there also can be unused quota if producers restricted output below q_2 . For example, the monopoly solution of p^* and q^* generates an unused quota of (q_2, q^*) .

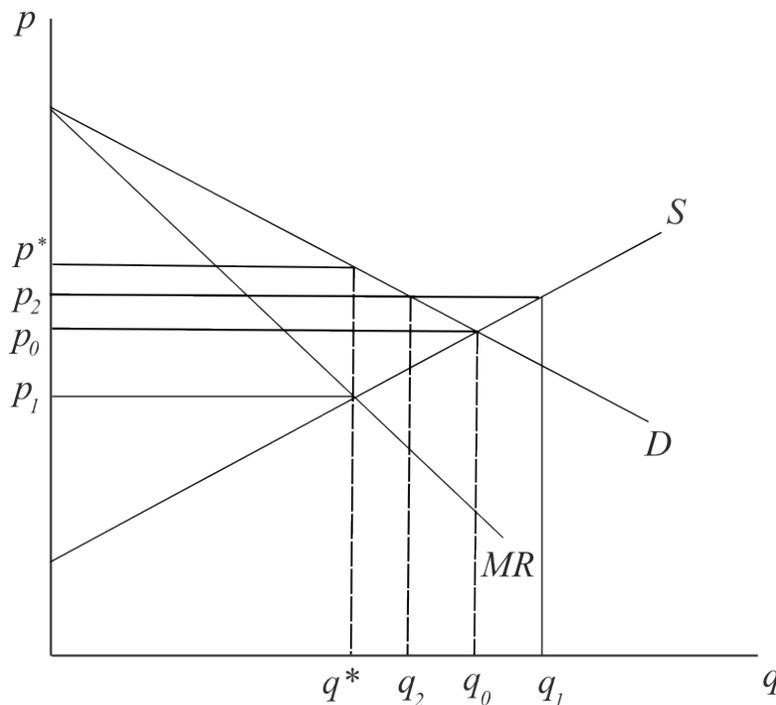


Figure 5. Binding and Non-Binding Quotas

For a quota of q_1 , as discussed earlier, under competition, (q_1, q_0) of the quota remains unused. As a result, from a theoretical perspective, the existence of unused quota

may or may not support anti-competitive behavior on the part of producers. However, true quota rents exist only under the binding production quota model.

5. In the previous discussions the production quota referred to is set by biologists using a reference point “maximum sustainable yield”. It is not set only with reference to economic supply and demand analysis as is the case for quota supply managed sectors in agriculture. If this is true, then the setting of a production quota of q_1 or q_2 has little reference to S and D and competitiveness as defined by economists. This makes it very difficult to establish the reference point upon which to base conclusions concerning anti-competitive behavior, and to define rents correctly!

TOR 5 continued

The following recommendations consider the future state of the fishery. In determining the potential for imperfect competitive behavior, it is necessary to consider the following:

1. Use of HHI and Horizontal Merger Guidelines

- 1.1. Based on theory alone, there is a limited possibility for price collusion.
- 1.2. CL backed 15.5% out of an HHI of 1500 from DOJ Horizontal Merger Guidelines as upper limit, but the DOJ still considers and allows mergers at higher levels.
- 1.3. The setting of a percentage share at 15.5% does not take into account the possibility that any scale efficiencies may be lost based on current technology and cost structure or that of the future.

- 1.4. An alternative approach would be to establish 1500 as the HHI above which ownership would not be allowed rather than setting a cap of 15.5%. Doing so would provide greater flexibility to allow entities to grow while maintaining the HHI at a level that is considered to be competitive.
- 1.5. The HHI should be monitored. If it falls within the range of 1500 to 2800 then review conduct and market performance.

2. Cost Efficiencies

- 2.1. As previously noted, the peer review panel emphasized the need to consider tradeoffs between economies of scale (economic efficiencies) and ownership caps. Doing so requires consideration of production function or cost relationships at the vessel-level and/or enterprise level. Additionally, there may be sector-l level economies of scale in terms of sector transactions costs or through ability to bargain for lower input prices and or engage in marketing. The full consideration of scale efficiencies would require cost data to evaluate structure of industry and the potential to realize lower costs through consolidation or expansion.
- 2.2. There are sector level economies of scale (as well as individual) through ability to bargain for lower input prices and or engage in marketing.
- 2.3. There are sector operating cost savings tied to that have the potential to exert MP.

3. The Relevant Unit of Regulation

3.1. There is a question over whether individuals are the sole relevant unit of regulation. As previously noted, sectors exist as institutions to achieve a certain level of coordination among their members. Under present conditions, this coordination is limited to facilitating reporting requirements to the NMFS and executing inter-sector trades. This rules out the possibility that coordination in ACE trading or product markets may occur in the future.

4. Other Comments

4.1. The CL's TOR included the possibility that market power metrics other than the HHI may be appropriate. Such an alternative may be the 4-firm concentration ratio.

4.2. The possibility exists on estimating market power using econometric methods, or identifying why it could not be done for this fishery (the NEFMC should be aware that these methods are established in the literature).

4.3. Their findings were based on anecdotal evidence, but importantly, what questions were asked? There was no information on whether the sample of people interviewed was representative of the population. The potential for collusion by sector or among sectors cannot be dismissed based on interviews alone, since institutions exist to achieve coordination among sector members. The unit of regulation should be any level that allows for institutions to coordinate activities to behave non-competitively. There is no scientific basis for ruling out the possibility that sector level coordination may occur.

- 4.4. The authors should have considered the empirical relationship between actual quota levels set by regulator, actual production of the fishermen and competitive prices and quantities. As shown theoretically, unless this is done, drawing conclusions on anti-competitive behavior is hazardous at best. If the theory were rigorously developed, one could help determine the potential for monopoly pricing.
- 4.5. The authors should have provided the time that their data and analysis cover. Further consideration should be given to the role that permit banks, non-profit permit banks and lease-only sectors may play in leasing markets and product markets.
- 4.6. It may not be necessary to have share limit for all stocks

Review of NMFS Process

The review process was very well carried out and extremely informative. Having the authors of the CLR give their findings to us (and to the general public) was well served. Many of my conclusions were based on the interaction between authors, panel reviewers, and fishery personnel at the June meeting.

Bibliography

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Appendix 1: Background material

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Mitchel, Glenn and Peterson, Steven. 2013. Recommendations for Excessive-Share Limits in the Northeast Multispecies Fishery. Compass Lexecon Report.

New England Fishery Management Council and the National Marine Fisheries Service. 2014. Overview of the Northeast Multispecies Fishery Management Plan. Background material for the June 12-13, 2014 peer review by the Center for Independent Experts of the Compass Lexecon report: “*Recommendations for Excessive Share Limits in the Northeast Multispecies Fishery.*”

Appendix 2: CIE Statement of Work

Statement of Work for Dr. Andrew Schmitz

External Independent Peer Review by the Center for Independent Experts

Evaluation of the study:

“Recommendations for Excessive Share Limits in the Northeast Multispecies Fishery”

Scope of Work and CIE Process: The National Marine Fisheries Service’s (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer’s Representative (COR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance with the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee, and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: The New England Fishery Management Council (NEFMC) has been developing Amendment 18 to the Northeast Multispecies Fishery Management Plan, and as part of the Amendment, has been attempting to define an "excessive share" threshold for the fishery. All federal fishery management plans must comply with National Standard 4 of the Magnuson Act (16 *U.S.C.* 1851(a)(4)), requiring that fishing privilege allocations be carried out so that "no particular individual, corporation, or other entity acquires an excessive share of such privileges." During the course of the Council’s deliberations, it was decided that additional expertise from an external contractor was needed to help determine if excessive shares exist in the fishery today and describe potential constraints that could prevent excessive shares from existing in the future. In order to provide this expertise, the economic consulting firm Compass Lexecon was contracted to give advice on an appropriate excessive share threshold for the Northeast Multispecies Fishery.

Compass Lexecon defined an “excessive share” as a share of access privileges and/or quota leasing that would allow an entity to influence the prices of fishery outputs to its advantage, or to have market power. The research involved receiving input from fishery stakeholders via surveys and interviews and analyzed NMFS fishery data. Compass Lexecon assessed available models for evaluating the presence of market power, and made recommendations with regard to their appropriateness for setting excessive catch share limits.

The work performed could be controversial. Examination of market power has never been formally investigated in this fishery. It recommended methods for determining excessive shares which might be applied in other fisheries. With the increased prevalence of catch share management systems, determining what constitutes an excessive share and whether limits need to be put in place is extremely important, because excessive shares may lead to market power. Market power can lead to the ability to influence price in either the final product market or in factors of production (i.e. the fish resource). Thus, the study by the Compass Lexecon was innovative and significant.

Compass Lexecon delivered its final report to the NEFMC on December 31, 2013, and a peer review (by the CIE) needs to take place to either endorse or reject their findings. Because Compass Lexecon was contracted by the NEFMC, the Northeast Fisheries Science Center (NEFSC) agreed to coordinate the review of the report on behalf of the NEFMC. The NEFSC has asked the CIE to formally conduct a review of the report.

The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have working knowledge and recent experience in the application of economics, with specific expertise in industrial organization. The reviewers should have theoretical and empirical expertise in the economics of market structure/conduct/performance, particularly monopoly/oligopsony, antitrust, firm strategy, and government regulation. Experience conducting studies using econometric models and/or index-based assessments of market concentration and market power would be useful. Experience with markets operating under government permits such as production permit or marketing orders in agriculture, bandwidth for TV and radio, and tradable permit systems would be desirable. Empirical studies of market structure in renewable resource industries would be desirable as would an understanding of the statutory context for antitrust regulation. Each CIE reviewer's duties shall not exceed a maximum of 16 days to complete all work tasks of the peer review described herein.

Not covered by the CIE, the CIE chair's duties should not exceed a maximum of 16 days (i.e., several days prior to the meeting for document review; the CIE panel meeting; several days following the panel meeting for Summary Report preparation).

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting. A meeting room has been reserved at the Hawthorne Hotel, 18 Washington Square West, Salem, Massachusetts 01970 on June 12 and 13, 2014.

Statement of Tasks: Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

1. Prior to the Peer Review Meeting:

Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email, FAX) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair (see below) a copy of the SoW, background documents and final report in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, home country, and FAX number) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: <http://deemedexports.noaa.gov/sponsor.html>.

Pre-review Background Documents: Approximately two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

2. During the Panel Meeting

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual

role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

(Review Meeting Chair)

A member of the New England Fishery Management Council's Scientific and Statistical Committee will serve as Chairperson. The role of the Chair is to facilitate the meeting, which includes coordination of presentations and discussions, and making sure all Terms of Reference are reviewed. Additionally, the Chair shall prepare the summary report from the meeting. During the meeting, the Chair can ask questions or make statements to clarify discussions, and he can move the discussion along to ensure that the CIE reviewers address all of the TORs.

(CIE Reviewers)

Each CIE reviewer shall participate as a peer reviewer in a panel discussion centered on a report furnished to the NEFMC by Compass Lexecon regarding excessive shares in the Northeast Multispecies Fishery. Reviewers are to determine whether the findings of the Technical Group are valid given the Terms of Reference provided to the expert panel. If reviewers consider the recommendations of the expert panel to be inappropriate, the reviewers should recommend an alternative.

(Compass Lexecon)

A representative from Compass Lexecon shall provide a presentation of their final report. During the question and answer period, the Compass Lexecon representative will be available to answer questions about the report. The CIE members can provide feedback to Compass Lexecon at that time.

(Other Panel Members)

A staff representative from the NEFMC and from the NEFSC Social Sciences Branch will be available during the meeting to provide any additional information requested by the CIE reviewers. These other panel members may assist the Chair in preparing the summary report, if requested.

(Public)

Day 1 of the panel meeting will be open to the public to attend as observers. The agenda will allow for limited public comment.

3. After the Open Meeting

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as

described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: The Chair from the SSC and CIE reviewers will prepare the Peer Review Summary Report. Each CIE reviewer will discuss whether they hold similar views on each Term of Reference and whether their opinions can be summarized into a single conclusion for all or only for some of the Terms of Reference. For terms where a similar view can be reached, the Summary Report will contain a summary of such opinions. In cases where multiple and/or differing views exist on a given Term of Reference, the Report will note that there is no agreement and will specify - in a summary manner – what the different opinions are and the reason(s) for the difference in opinions.

The Chair’s objective during this Summary Report development process will be to identify or facilitate the finding of an agreement rather than forcing the panel to reach an agreement. The Chair will take the lead in editing and completing this report. The Report (please see Annex 1 for information on contents) should address whether each Term of Reference was completed successfully. For each Term of Reference, this report should state why that Term of Reference was or was not completed successfully.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

- 1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
- 2) Participate during the panel review meeting in Salem, Massachusetts during June 12-13, 2014 as specified herein, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
- 3) No later than 27 June, 2014, each CIE reviewer shall submit an independent peer review report addressed to the “Center for Independent Experts”, and the report should be sent to Dr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in **Annex 1**, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

5 May 2014	CIE sends reviewer contact information to the ST Coordinator, who then sends this to the NMFS Project Contact
26 May 2014	NMFS Project Contact sends the CIE Reviewers the pre-review documents
12-13 June 2014	Each reviewer participates and conducts an independent peer review during the two-day panel review meeting
27 June 2014	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
7 July 2014	Draft of Summary Report, reviewed by all CIE reviewers, due to panel Chair *
14 July 2014	Panel Chair send final Summary Report, approved by CIE reviewers, to NEFSC contact
14 July 2014	CIE submits CIE reports to the ST Coordinator
21 July 2014	The ST Coordinator distributes the final CIE reports to the NMFS Project Contact and regional Center Director

*The Summary report will not be submitted, reviewed, or approved by the CIE

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COR within 10 working days after receipt of all required information of the decision on substitutions. The COR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:

- (1) Each CIE report shall be completed with the format and content in accordance with **Annex 1**,
- (2) Each CIE report shall address each ToR as specified in **Annex 2**,
- (3) The CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COR. The COR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations in accordance with the ToRs.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.
 - a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.
 - b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.
 - c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.
 - d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.
 - e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.
3. The reviewer report shall include the following appendices:
 - Appendix 1: Bibliography of materials provided for review
 - Appendix 2: A copy of the CIE Statement of Work
 - Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Evaluation of the study: “Recommendations for Excessive-Share Limits in the Northeast Multispecies Fishery”

The peer review shall be conducted based on the following Terms of Reference (ToRs):

1. Describe the method or process used by Compass Lexecon for determining the maximum possible allowable percentage share of the market for fishery access privileges and/or quota leasing that would prevent an entity from obtaining an excessive share of access privileges allocated in the Northeast Multispecies Fishery.
2. Evaluate the strengths and weaknesses of the proposed method or process developed by Compass Lexecon (e.g., whether defining excessive shares in terms of market power is appropriate and adequate). Evaluate whether the approach outlined by Compass Lexecon is reasonable for setting excessive share limits in fisheries managed through catch shares in general. As part of this TOR, comment on any constraints that may hinder application of the proposed approach.
3. Evaluate application of the proposed methods or process to the Northeast Multispecies Fishery. Are Compass Lexecon’s conclusions regarding market power in both the final product (seafood) and production (quota) market valid and based on appropriate economic principles? If there is disagreement with what Compass Lexecon recommended, clearly state that and your reason why.
4. Review and comment on the data requirements necessary for applying the proposed methods or process.
5. Provide any recommendations for further improvement.

Annex 3: Tentative Agenda

Evaluation of the study: “Recommendations for Excessive-Share Limits in the Northeast Multispecies Fishery”

Location: Hawthorne Hotel, 18 Washington Square West, Salem, MA 01970

Date: June 12-13, 2014 (two day)

Day 1: Thursday June 12

- 9:00 Opening, Panel Chair (SSC representative)
- Welcome
 - Introduction
 - Agenda overview
 - Conduct of meeting
- 9:15 Background and Need for Compass Lexecon Report, NEFMC Staff (Rachel Feeney)
- 9:25 Background of Compass Lexecon Report and Introduction of Compass Lexecon, NMFS Project Contact (Chad Demarest)
- 9:35 Report of Compass Lexecon (Steve Peterson and/or Glenn Mitchell)
- 10:10 Break
- 10:25 Review of Terms of Reference – CIE Panel
- 10:45 Public Comment
- 11:00 CIE Panel Discussion – ToR #1
- 12:00 Lunch
- 1:00 CIE Panel Discussion – ToR #2
- 1:45 CIE Panel Discussion - ToR #3
- 3:00 Break
- 3:15 CIE Panel Discussion - ToR #4
- 3:45 CIE Panel Discussion – ToR #5
- 4:15 Public Comment
- 4:30 CIE Panel Discussion – Outstanding Issues
- 5:00 Adjourn

Day 2: Friday June 13

- 8:00 – 2:30 CIE Report Writing – (Only Panel Members, NEFMC and NEFSC staff are admitted)

Appendix 3: Panel Membership

Review Panel Chair

Dr. Eric Thunberg
(NEFMC Science and Statistical Committee
NOAA HQ Office of Science & Technology

Review Panelists

Dr. Trond Bjorndal
SNF Centre for the Applied Research at NGG
Bergen, Norway

Dr. Jamie Brown Kruse
Director, Center for Natural Hazards Research,
East Carolina University
Greeneville, NC USA

Dr. Andrew Schmitz
Department of Food and Resource Economics
University of Florida
Gainesville, FL USA

Dr. Quinn Weninger
Department of Economics
Iowa State University
Ames, Iowa USA

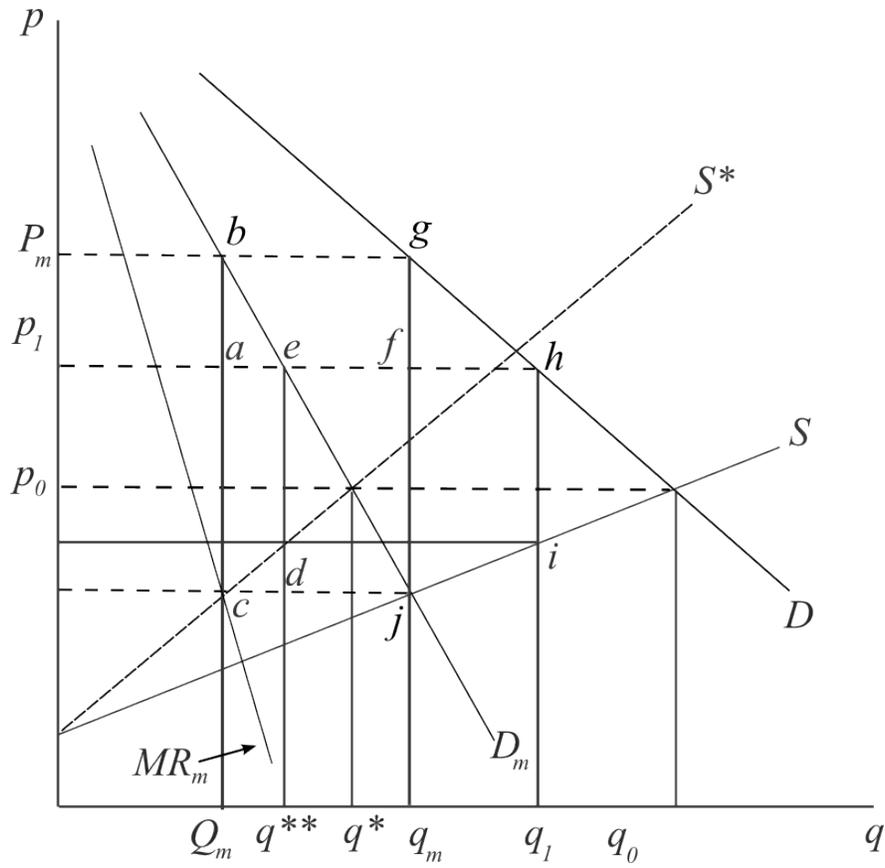
Appendix 4: Monopoly Pricing

The Compass Lexecon Report (CLR) implies that dominant firm pricing would be the behavior that would bring about anti-competitive behavior. Dominant firm pricing is now discussed with reference to Appendix Figure 1. Under non-competitive pricing, and competition, the dominant firms' producers catch q^* of fish. This is reduced to q^{**} under a production quota.

If the dominant firms collectively have market power, they can reduce the quantity of their fish catch to Q_m by equating the marginal revenue MR_m to the demand D_m and charging price P_m . In so doing, the dominant firms gain $[(P_m p_1 ab) - (acde) > 0]$. The fringe firms also benefit. Note the important result: the total q_m is less than the level q_1 set by the quota.³ It is important to note that the dominant firms' gain is dependent on the elasticities used in the model.

The CLR notes the observation that often, the actual total catch is smaller than the quota amount but they deemphasize the possibility of monopoly pricing creating the situation of unused quota.

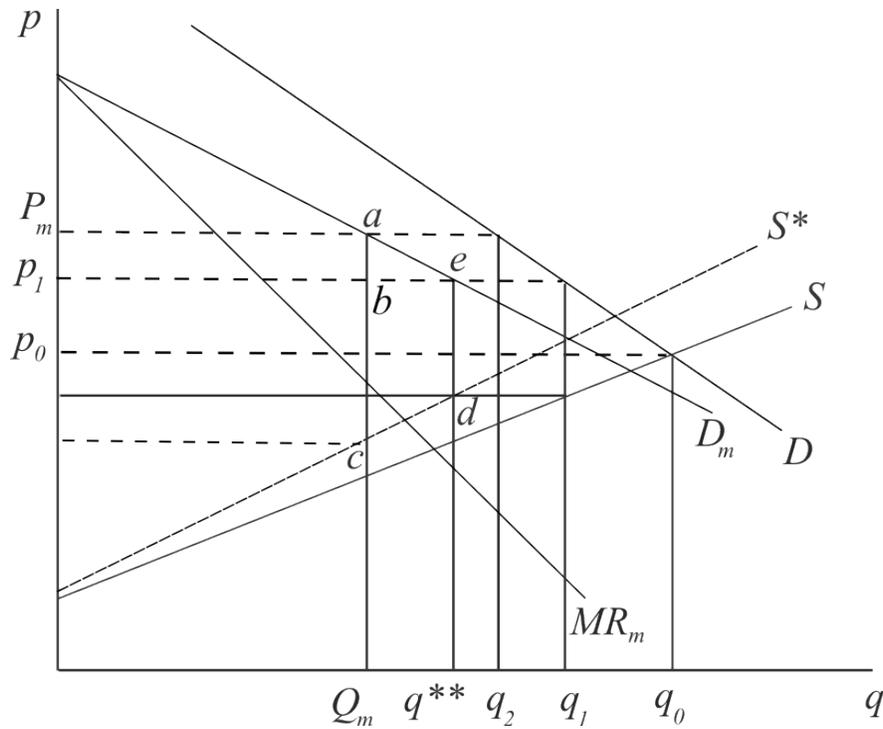
³ To my knowledge, a dominant firm model has never been developed within the context of a production quota set by a regulator. The standard dominant firm theory is based on competitive equilibrium behavior benchmark (Schmitz et al., 1981). Because of the presence of a production quota, the residual demand curve facing the dominant firm may be somewhat different than D_m in our model. It is beyond the scope of this discussion to rigorously develop the slope of D_m relative to D . Our purpose is to highlight the effect of dominant firm pricing in the context of a production quota.



Appendix Figure 1. Non-competitive Pricing

Note that in Appendix Figure 1, the output of the fringe firms decreases from $q^{**}q_1$ to q_mQ_m under monopoly pricing. Both the dominant firm and the fringe firms gain from monopoly pricing. The gain to the fringe firms is given by $[(bafg) - (fjih)]$.

Now consider Appendix Figure 2 that shows the possibility that the output of the fringe firms could increase due to monopolization by the dominant firms. As before, S^* is the supply curve of the dominant firms and S is the total supply. The competitive equilibrium price and quantity are p_0 and q_0 . Given a quota q_1 , price increases to p_1



Appendix Figure 2. Increase in Production by Fringe Firms due to Monopoly Pricing

Now suppose that the dominant firms face demand D_m . Under monopoly pricing by the dominant firms, price is P_m and quantity is Q_m . In this case, output of the fringe increases in response to monopoly pricing (from $q_1 q_0^{**}$ to $q_2 Q_m$). But, note however that the monopoly loses from the attempt at monopolization. The loss is given by $[(P_m p_1 ba) - (bcde)]$. Thus it takes a particular combination of market shares and price elasticities to arrive at a result in which monopolization leads to both an increase in profits for the monopoly, and an increase in production (along with profits) for the fringe firms.